Traumatic Brain and Spinal Cord Injury Associated with All-Terrain Vehicle Use, Louisiana 1996-1999

Injury Research and Prevention Section

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Introduction

Throughout the United States, all-terrain vehicles (ATVs) continue to be a major cause of injury and death, especially among children. Louisiana, particularly the northeastern part of the state, had a large number of injuries and death associated with all-terrain vehicle use. Traumatic brain injuries (TBI) and spinal cord injuries (SCI) often represent the more serious injuries sustained in ATV crashes. From 1996 to 1999, there were 117 identified cases of ATV-related TBI and SCI among Louisiana residents. More than half of these injuries occurred among children aged 16 years and younger. There is a need for intervention to prevent this type of injury in the future.

Data in this report are from the Louisiana Traumatic Brain and Spinal Cord Injury Registry. The Registry is maintained by the Injury Research and Prevention Section of the Office of Public Health. Data are collected from hospital records and death certificates. Analysis of four years of this population-based data provided the information contained in this report. Hospital discharge summaries, radiology reports, emergency department admission records and toxicology reports were reviewed for 71% (n=83) of ATV-related TBI and SCI to ascertain additional information to describe the circumstances and severity of the injuries. (More detail on the data collection method is reported in Appendix A.)

Data analysis found that in Louisiana white males are at highest risk for sustaining an ATV-related TBI or SCI. The majority of injuries occurred to those aged 16 years or younger. The highest rate of ATV-related TBI and SCI occur in the northeastern region of the state. For TBI in which helmet use was known, only 11% of persons were wearing a helmet at the time of the injury. The majority (78%) of those with an ATV-related TBI or SCI were discharged to home.

Background

All-terrain vehicles are three- or four-wheeled motorized cycles with oversized low pressure tires that are designed to be operated off-road by one person at a time.[1] ATVs were first introduced to the United States in 1971 as a utility vehicle for farmers and ranchers. ATVs are not designed to be used on paved roads, and therefore, are not regulated by a government agency. The ATV was marketed as a smaller, more economical alternative to tractors or trucks to be used to reach outlying areas such as fields, wooded areas, and other regions not easily accessible by larger vehicles. It was not until the early 1980's that the recreational use of ATVs became popular, especially among young persons who were not of legal age to drive. ATV sales are on the rise throughout the United States as well as the rest of the world. In 1993 an estimated 2.5 million ATV were in use throughout the United States and in 1996 over 300,000 new ATVs were sold.[1]

Injury and death as a result of ATV use

Injury and death have been closely associated with ATV use since its introduction in the 1970's and continue to be a problem especially among ATV users 16 years of age and younger. In the United States throughout the 1980's the number of injuries and deaths related to ATV use dramatically climbed to 300 deaths and 108,000 injures in 1986.[2] An estimated 40% of these injuries and deaths occurred among children 16 years and younger.[3] This is disproportionate to the proportion of the population in this age group. According to the 1990 US Census, approximately 24% of the US population was 16 or younger.[4] This led the United States Consumer Product Safety Commission (CPSC) and ATV manufacturers to create and sign "Consent Decrees" in 1988. These decrees were designed to decrease the number of ATV-related deaths and injuries. These agreements included the following seven conclusions and recommendations:[5]

1. stop the production and sale of three-wheeled ATVs
2. recommend that no passengers ride on ATVs
3. develop and offer free safety courses for beginning drivers
4. develop age-engine size requirements
5. discourage use of ATV on roads
6. require children under the age of 16 to have adult supervision
7. require helmet use

Injury and death associated with ATV crashes steadily decreased following the "Consent Decrees". From 1986 to 1994 the number of deaths and injuries associated with ATV use had decreased more than 40%. In 1994, the number of deaths related to ATV use had declined to 173 and the number of injuries was reported to be an estimated 59,200.[2] However, 40% of these deaths and injuries still occurred among children 16 and under.

Traumatic Brain and Spinal Cord Injury associated with ATV use

A large proportion of injuries associated with ATV use results in a traumatic brain injury. Several studies have examined the prevalence of TBI and SCI among persons injured during an ATV crash. One study estimated that 25% of all injuries were TBI or SCI.[6] Other studies reported that an estimated 29-48% of all persons injured in an ATV crash sustain a traumatic brain injury, while 4-11% sustain a spinal cord injury. A large proportion of the deaths associated with ATV use involved brain injury. Those injuries involving trauma to the brain were among the most severe ATV-related injuries.[5,7,8]

The use of a helmet as a protective device

Many studies have shown that the use of a helmet while riding an all-terrain vehicle can drastically reduce the chances of sustaining a brain injury during a crash.[7,8,9] One study showed that helmet use reduces the risk of death by 42% and could reduce the chances of brain injury by 64%.[9] Despite this information, helmet use, especially among persons 16 years of age and younger, is continues to be low. Estimated helmet usage frequencies range from 10-40%.[1,5,8]

Case studies of injuries that occurred to Louisiana residents

- A 17-year old female was thrown from a four-wheel ATV and hit her head on a stump. When she arrived at the emergency room, she had trouble breathing and did not know her mother. CAT scans showed she had a spine fracture and many rib fractures. After some time in the hospital, and despite intensive efforts, she was declared brain dead.

- A 14-year old male was riding a three-wheel ATV on a road without a helmet. He crashed and went to the hospital with a concussion, compression fractures of the spine, and third-degree burns. He was transferred from the hospital to a burn center and had to wear a back brace for six weeks.

- A 4-year old female was riding on the front of a four-wheel ATV while her cousin drove. He could not make a curve, so he grabbed her before the four-wheeler flipped and rolled over several times. The two hit heads and the child was not responsive when she arrived at the hospital.

- A 7-year old boy was riding a three-wheel ATV with his father. They lost control and the boy hit his head on a telephone pole. He lost consciousness for 10 minutes and was admitted to the hospital for observation.

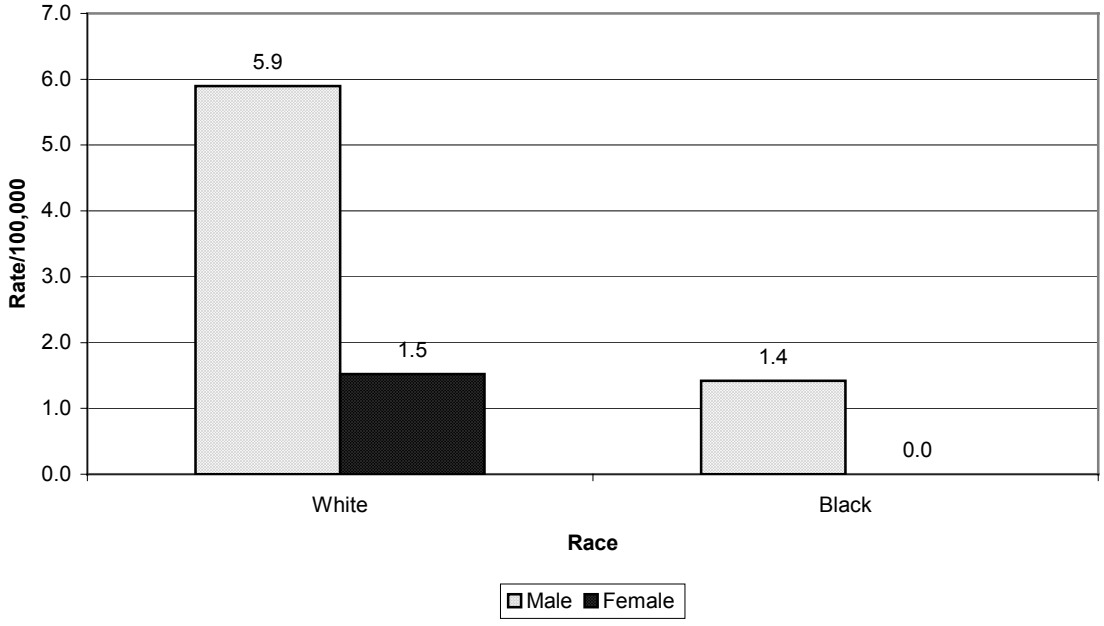
Results

There were 117 cases of ATV-related TBI and SCI reported in Louisiana from 1996 to 1999 (1996: 35 cases, 1997: 25 cases, 1998: 27 cases, 1999: 30 cases). The majority (n=111) of cases were traumatic brain injuries, with 6 spinal cord injuries identified in the surveillance system. Based on previous studies, we can estimate that there were an additional 127-286 persons injured while riding an all-terrain vehicle between 1996 and 1999 that did not sustain a traumatic brain or spinal cord injury.[5,7,8] The overall annual incidence rate of ATV-related injuries in Louisiana was 0.7 per 100,000 residents. In 1999 there were 92,325 registered ATVs in Louisiana.[10] This allows us to estimate that there were 32 TBI and SCI per 100,000 registered ATVs each year. It has been shown previously that the estimated injury rate for registered ATVs is higher for children than for adults.[6] The same study also found that for children, boys are more than twice as likely to sustain ATV-related injuries as compared to girls.[6]

Who experienced ATV-related TBI and SCI?

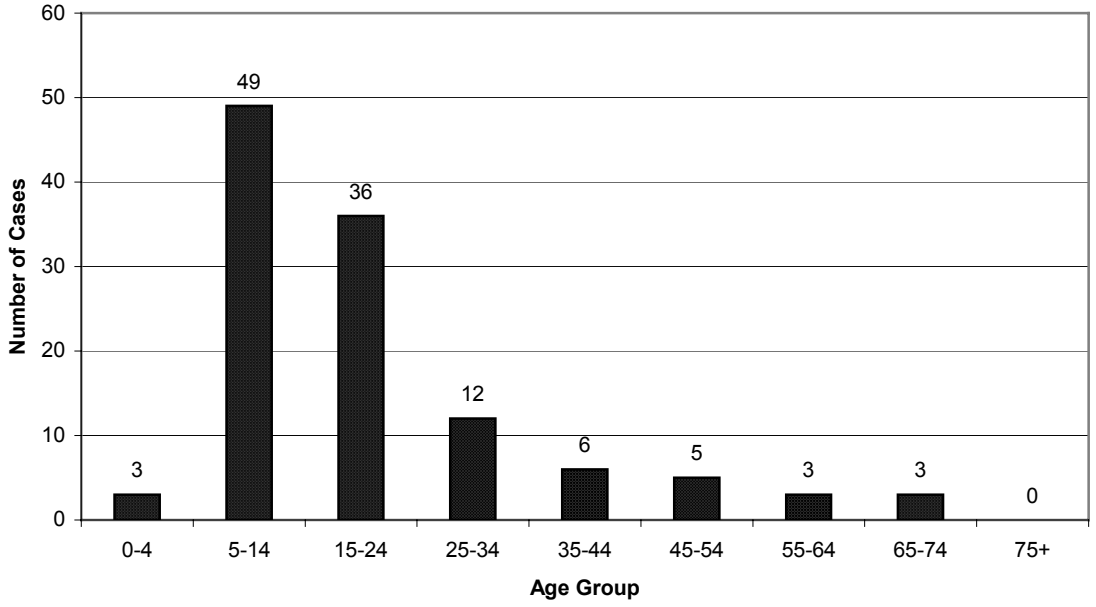
Of the 117 persons who were injured, 104 were white, 10 were black, and 3 were of other or unknown race. All ten blacks were male. Twenty-one of the 104 whites were female and the remaining 83 were male. All three cases where race was unknown or other occurred in males. White males were almost four times more likely to experience an ATV-related TBI than black males (Figure 1).

FIG. 1: ATV-Related TBI and SCI Incidence by Race and Sex, LA 1996-1999 (N=114)



ATV-related TBI and SCI is a major problem among the younger population of Louisiana. Fifty-four percent of all ATV-related TBI and SCI occurred to children ages 16 and younger. Over three-quarters (77%) of ATV-related injuries occurred among persons younger than 25 years of age (Figure 2).

FIG. 2: Cases of ATV-Related TBI and SCI by Age Group, LA 1996-1999 (N=111)



What types of injuries were sustained in these crashes?

Medical charts were reviewed for some of the ATV-related TBI. Some of the information collected was whether medical tests were done to look for evidence of skull fractures or intracranial bleeding, both of which confirm a head injury. These tests also provide an idea of the extent of the TBI. Of the 77 persons for which the information was available to determine the extent of injury, 21 suffered a skull fracture and 33 sustained intracranial bleeding. Twelve of these sustained both a skull fracture and intracranial bleeding.

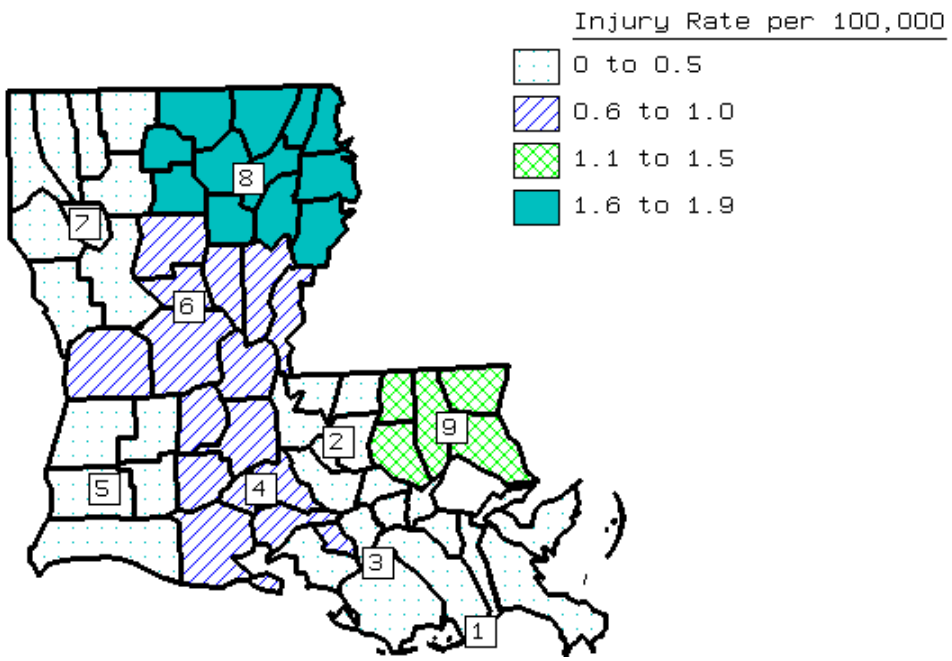
There were six ATV-related spinal cord injuries identified. Of these, the extent of the injury was known for five cases. Four persons suffered injuries for which functional movement was not expected to be regained. The remaining person was expected to regain functional movement of the extremities.

Where did ATV-related TBI and SCI occur in Louisiana?

Over half (n=45) of the parishes throughout Louisiana had residents who experienced cases of ATV-related TBI and SCI from 1996 to 1999. The parishes with the greatest number of ATV-related injuries include: Ouachita (n=13), Jefferson (n=6), Washington (n=6), Plaquemines (n=5), St. Landry (n=5), and St. Tammany (n=5). The following figure (Figure 3) illustrates that we see the highest rates of ATV-related TBI and SCI in the northeastern part of Louisiana. Eight percent of Louisiana's population lives in Louisiana Region 8 (which includes Monroe), however 24% of all the ATV-related TBI and SCI injuries from 1996 to 1999 occurred in this Region. ATV injuries do, however, continue to occur throughout the state.

Note: Regional data may be unstable due to the relatively small number of cases statewide.

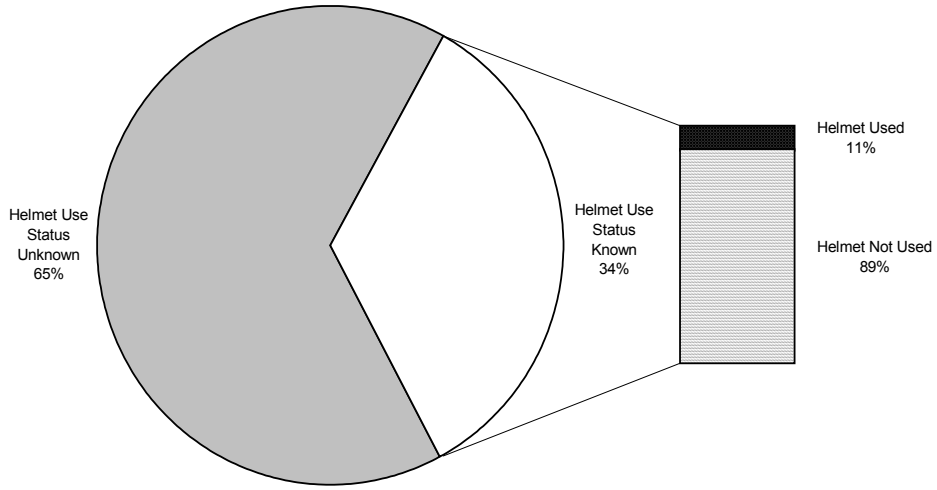
FIG. 3: Incidence Rate of ATV-Related TBI and SCI by OPH Region, LA 1996-1999 (N=117)



What about helmet usage in these crashes?

Helmet use status was unknown for 73 cases in which the person sustained a TBI. For those injuries in which helmet use status was known (n=38), only 4 persons who sustained a TBI were known to be wearing a helmet at the time of their ATV crash. Of the 38 ATV-related TBI injured persons with helmet use status known, 34 were not wearing a helmet at the time of the injury (Figure 4).

FIG. 4: Helmet Use in ATV-Related TBI, LA 1996-1999 (N=111)



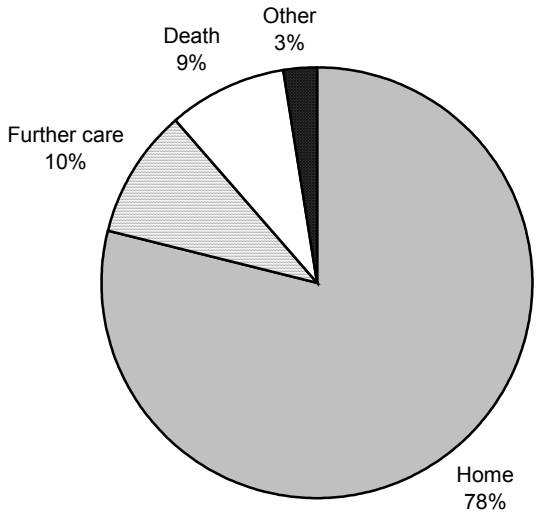
What position was the injured riding in at the time of the crash?

Over 15% (n=12) of the riders who were injured were a passenger on an ATV. As stated earlier, the "Consent Decrees" drafted by the CPSC and ATV manufacturers recommend that ATVs carry no passengers. These types of vehicles are not designed to carry more than one person at a time. Over three-quarters (76%, n=54) of the injured riders were the driver of an ATV.

What is the outcome of ATV-related TBI and SCI?

Ten of the ATV-related TBI and SCI resulted in death, while another 11 persons required further care. Further care includes rehabilitation, skilled and non-skilled assistance, or further acute care. The majority (n=90) of persons were discharged to home following their hospitalization (Figure 5).

FIG. 5: Outcome Following ATV-Crash Related TBI and SCI, LA 1996-1999 (N=114)



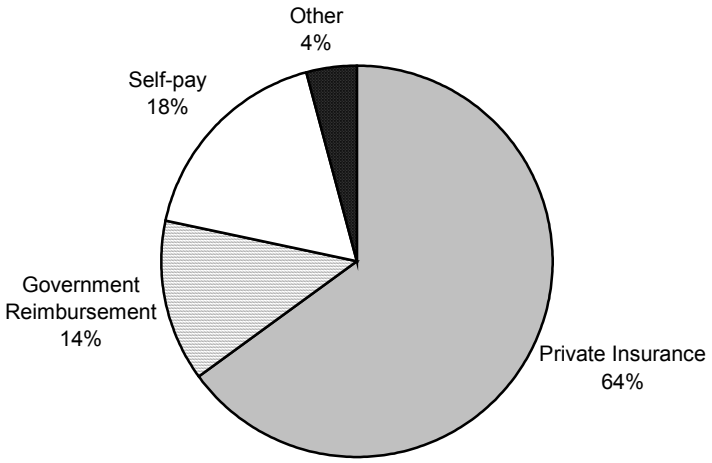
What about alcohol involvement?

Alcohol was known to be involved in 10 (13%) of the 79 cases for which information was available. Of these 10 cases, 6 were higher than Louisiana's legal limit for blood alcohol concentration. Testing for blood alcohol level was not performed for 64 of the cases. The remaining 5 cases (6%) were tested for alcohol use and were negative.

Who is paying for treatment of ATV-related TBI and SCI?

More than half of all hospitalizations (n=48) were paid for by private insurance companies. Almost one in five (18%, n=13) were uncompensated. Fourteen percent (n=10) of medical costs for patients were reimbursed by the government (i.e. Medicare, Medicaid). Other methods of payment (including worker's compensation) accounted for 4% of hospitalization costs (Figure 6).

FIG. 6: Payment Source for ATV-Crash Related TBI and SCI, LA 1996-1999 (N=74)



Conclusions and Recommendations

In the United States, all-terrain vehicle crashes have injured disproportionate numbers of children and young adults since their introduction nearly 30 years ago. Consistent with national data, the majority of those who sustained an ATV-related injury were children 16-years old and younger. Northeastern Louisiana has a higher rate of ATV-related injuries in comparison with the rest of the state, with a rate more than twice as high as the overall state rate (1.9 per 100,000 and 0.7 per 100,000, respectively). Recommendations toward reducing this type of injury should be followed. Recommendations should include efforts to promote helmet use by ATV users, particularly among persons under the age of 25.

A new approach to ATV safety was implemented recently in part of Louisiana. In September 1999, the ATV Safety Alliance was formed in the Monroe area. Office of Public Health officials, local injury prevention programs such as Safe Kids and Think First, various hospital personnel, representatives from various hunting and fishing organizations, local and state police, and insurance company representatives came together in northeastern Louisiana to form the group. The mission of the ATV Safety Alliance is to educate the public and increase awareness of safe riding techniques and the potential dangers of operating an ATV. A public awareness campaign was done using television, radio and newspaper sources.

The materials used by the ATV Safety Alliance, including a brochure and safety tip sheet, are available for statewide dissemination or for continued localized dissemination. For copies of the materials, contact the Injury Research and Prevention Section at (504) 568-2509. These tips include:

- Always wear a helmet when riding an ATV (approved motorcycle helmets).
- Only one person should ride on an ATV at a time.
- Always ride ATVs off-road.

While the northeastern part of Louisiana seems to experience the greatest rates of ATV injuries, it is apparent that many other parishes throughout the state might benefit from similar community-based prevention programs.

Appendix A

Case Definition

The following case definitions are those recommended by the Centers for Disease Control and Prevention.

Traumatic Brain Injury

A case of traumatic brain injury (TBI) is defined as either an occurrence of injury to the head that is documented in a medical record with one or more of the following conditions attributed to head injury:

- observed or self-reported decreased level of consciousness
- amnesia
- skull fracture
- objective neurological or neuropsychological abnormality
- diagnosed intracranial lesion
- occurrence of death resulting from trauma, with head injury listed on the death certificate, autopsy report, or medical examiner's report in the sequence of conditions that resulted in death [4]

Spinal Cord Injury

A case of spinal cord injury is defined as the occurrence of an acute traumatic lesion of neural elements in the spinal canal (spinal cord and cauda equina), resulting in any degree of sensory deficit, motor deficit, or bowel or bladder dysfunction, either temporary or permanent.

The clinical definition of spinal cord injury excludes the following:

- intervertebral disc disease
- vertebral injuries in the absence of spinal cord injury
- nerve root avulsions and injuries to nerve roots and peripheral nerves outside the spinal canal
- birth trauma
- cancer, spinal cord vascular disease, and other nontraumatic spinal cord diseases[4]

Methods

The Louisiana TBI-SCI surveillance system has two components: hospital data and mortality data.

Hospital Data

There are 149 hospitals in Louisiana that are licensed by the Department of Health and Hospitals. Currently, data is received from 118 hospitals throughout the state. Hospitals send information containing hospital codes, race, gender, age, dates of admission and discharge, discharge disposition, and personal identifiers. This information also includes a code for the external cause of injury in many cases. Office of Public Health personnel then travel to various hospitals to obtain additional information on a sample of TBI cases (approximately 40% of all cases) and all SCI. The variables obtained from the sample include information surrounding the event of the injury such as the use of personal protective equipment, drug and alcohol involvement. The presence of a skull fracture, intracranial hemorrhage, and the level of consciousness is also obtained.

Mortality Data

Louisiana maintains a file of all deaths throughout the state. These data include information concerning residence, gender, race, date of birth, date of death, place of injury, and codes for the related injuries as well as the external cause of injury, as well as personal identifiers. These data were queried for persons who died as a result of a traumatic brain or spinal cord injury from 1996 to 1999. Those persons were then cross-referenced with those persons identified through the hospital data to delete duplications. By combining these two data sources we are able to identify pre-hospitalization deaths.

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